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Research Paper

Longitudinal injecting risk behaviours among people with a history of injecting drug use in an Australian prison setting: The HITS-p study

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ABSTRACT

Background: HCV transmission remains high in prisons globally. Understanding injecting risk behaviours in prisons is crucial to effectively develop and implement HCV prevention programs in this setting including treatment as prevention.
Methods: HITS-p is a cohort study which enrolled people with a history of injecting drug use in prisons in NSW, Australia from 2005 to 2013. Participants completed an interview at enrolment and follow-up visits to determine injecting behaviours. Generalized estimating equation (GEE) and logistic regression methods were used to assess injecting risk behaviours prior to and following prison entry and to investigate injecting risk behaviours in prison.
Results: Overall, 499 participants with a history of injecting drug use were included (median age, 26 years; 65% male). Participants were significantly less likely to inject drugs following incarceration. Among injectors, participants were less likely to inject ≥weekly but more likely to share a needle/syringe. At enrolment, the proportion reporting any injecting, ≥weekly injecting, and needle/syringe sharing in prison was highest among younger individuals. Younger age was associated with both re-initiation and continuation of injecting drug use following prison entry. Among those continuously imprisoned, younger age was associated with increased odds of any injecting, ≥weekly injecting, and sharing a needle/syringe.
Conclusions: Upon entry to prison, injecting drug use decreased but syringe sharing increased among injectors. Younger individuals are most likely to exhibit high-risk injecting behaviours in prison. These data highlight the need for improved HCV prevention strategies (including improved needle/syringe access and scale up of HCV therapy) for those at increased risk of HCV transmission in prison, including younger individuals.

Introduction

In most countries, drug policies often result in the incarceration of people who inject drugs (PWID) for the use or possession of drugs (Dolan et al., 2016). Injecting drug use is known to continue in the prison setting (Bretana et al., 2015; Dolan et al., 2016; Hayashi et al., 2009; Kinner, Jenkinson, Gouillou, & Milloy, 2012; Pollini et al., 2009) and is a key route for the transmission of HIV and hepatitis C virus (HCV) infections (Hajarizadeh, Grebely, & Dore, 2013; Lavanchy, 2009; Nelson et al., 2011). However, in most countries, harm reduction strategies, such as high-coverage needle and syringe programs (NSP) and opioid substitution therapy (OST), that have been demonstrated to be effective in the prevention of HIV and HCV infections, are unavailable in prisons (Aspinall et al., 2014; Degenhardt et al., 2010; Grebely et al., 2015; Hagan, Pouget, & Des Jarlais, 2011; MacArthur et al., 2014; Nolan et al., 2014; Platt et al., 2016; Tsui, Evans, Lum, Hahn, & Page, 2014; Turner et al., 2011; van den Berg et al., 2007; White, Dore, Lloyd, Rawlinson, &

Abbreviations: NSW, New South Wales; HCV, hepatitis C virus; GEE, generalized estimating equation; PWID, people who inject drugs; NSP, needle and syringe program; OST, opioid substitution therapy; OR, odds ratio; aOR, adjusted odds ratio; CI, confidence interval; DAA, direct acting antiviral.

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Maher, 2014). Combined with the disproportionately high prevalence of blood borne viruses among prison inmates globally (Dolan et al., 2016), correctional centres are a high-risk environment for the acquisition and transmission of HCV and HIV (Abiona, Balogun, Adefuye, & Sloan, 2009; Butler, Levy, Dolan, & Kaldor, 2003; Cunningham et al., 2017; Fazel, Bains, & Doll, 2006; Indig et al., 2009; Larney et al., 2013). As such, prisons represent a key setting to deploy both prevention and treatment strategies for PWID. In Australia, while the prevalence of HIV in prisons is low (<1%) the seroprevalence of HCV is considerably higher with approximately half of PWID in prison being HCV antibody positive (Butler, Callander, & Simpson, 2015).

There exists limited data globally on injecting risk behaviours among PWID in prisons to inform the effective targeting of harm reduction and treatment strategies. Previous studies that have investigated injecting risk behaviours in prison settings have been limited to single prisons or have been retrospective or cross-sectional, thus limiting the evaluation of longitudinal injecting risk behaviours prior to and during imprisonment (Fazel et al., 2006; Kinner, Milloy et al., 2012; A. Watkins, Mak, & Connelly, 2011; Wright, Tompkins, & Farragher, 2015). In an observational cohort of people with a history of injecting drug use at risk of HCV infection in Australia (the HITS-p study), the incidence of primary HCV infection was 6.3 cases per 100 person-years among the continuously imprisoned population (Cunningham et al., 2017). Further, needle and syringe sharing in prison was associated with incident HCV infection, highlighting the importance of ongoing injecting risk behaviours for acquisition of HCV infection in prison (Cunningham et al., 2017). As such, we sought to investigate injecting risk behaviours among a population of prisoners with a history of injecting drug use, including a longitudinal characterisation of injecting behaviours among those entering prison, and among those continuously in prison. These data are needed to assist in designing more sophisticated strategies to prevent HCV transmission in the prison setting.

This study aimed to investigate changes in injecting risk behaviours and drug use patterns prior to, and during, incarceration among people with a history of injecting drug use enrolled in the HITS-p cohort between 2005 and 2014. This study also aimed to evaluate factors associated with re-initiation of injecting drug use and the association between age and ongoing injecting risk behaviours in prison.

Methods

Study design and population

HITS-p was a prospective cohort of prisoners enrolled between 2005 and 2013 and followed until 2014 in New South Wales (NSW), Australia. Enrolment occurred in two distinct enrolment periods (2005–2009 and 2012–2014) with a period of no enrolment in the intervening time. Adult male and female inmates were recruited in 23 of 35 correctional centres in NSW and followed across 30 centres as described previously (Dolan et al., 2010).

Participants were enrolled into the HITS-p cohort if they: were currently incarcerated in a NSW prison; had reported a life-time history of injecting drug use (enrolled 2005–2009) or a life-time history of any risk factors for blood-borne virus transmission (i.e., injecting drug use, tattooing, piercing, blood fights; enrolled 2012–2014); and had negative anti-HCV antibody status documented prior to recruitment (Dolan et al., 2010).

Of the participants enrolled in HITS-p, the current analysis included participants who were 18 years or older, had a lifetime history of injecting drug use, and provided written informed consent.

Ethical approval

The study was approved by the Human Research Ethics Committees of Corrective Services New South Wales (no. 05/0884) and of Justice Health (no. GEN 31/05).

Study assessments

At enrolment, participants were interviewed using a previously validated schedule (Dolan et al., 2010) to record demographic characteristics and injecting behaviour before, and during, the current imprisonment. Participants were asked about their recent drug use and injecting risk behaviours in the last three months prior to entering prison, and in the period since entering prison. Participants completed structured follow-up interviews at 6–12-month intervals while in prison, to ascertain risk factors for HCV transmission, and receipt of OST. Participants who were released to freedom after enrolment were followed up in the case of re-incarceration and thus the intervening periods may contain time spent outside of prison in these cases. All measures of recent drug use and injecting risk behaviours at follow-up were asked in regards to the time since their previous visit. Follow-up interviews and blood collection were performed by a research nurse, whose employment was independent of the custodial authority. The interview questions avoided disclosure of specific details of individual injecting or risk behaviour events (as such events may constitute criminal behaviour necessitating reporting to authorities).

Participation was voluntary, and all participants provided written informed consent. Participants received payment (AUD $10) following each visit through the approved prison inmate banking system to compensate for their time and effort in completing research interviews and providing blood samples.

Study outcomes

The primary study outcomes investigated included recent injecting drug use, ≥weekly injecting drug use (among those who reported any injecting), and needle/syringe sharing (among those who reported any injecting). This study also evaluated continued injecting drug use in prison, defined as any injecting drug use since prison entry at enrolment, among people who reported injecting drug use in the three months prior to prison entry. Lastly, this study evaluated the re-initiation of injecting drug use in prison among people with a history of injecting drug use who had not injected in the three months prior to prison entry.

Statistical analyses

The first aim was to evaluate changes in injecting risk behaviours prior to incarceration as compared to the first study visit following incarceration. Factors of interest included any injecting drug use, ≥weekly injecting drug use (among those who reported injecting), and any needle/syringe sharing (among those who reported any injecting). The proportion of participants who reported injecting risk behaviours prior to, and following, incarceration were tabulated. To characterize the association between age and injecting risk behaviours in prison, injecting risk behaviours at the first visit following incarceration were also summarized according to age group (< 25, 25–29, 30–34, 35–40, and ≥40 years).

Next, the types of drugs injected prior to incarceration as compared to the first study visit following incarceration were evaluated. Among people who reported injecting drug use in the three months prior to entering prison, changes in injecting frequency, needle/syringe sharing, methamphetamine injecting,

cocaine injecting, heroin injecting, buprenorphine/methadone injecting, and other opioid injecting were assessed.

To assess changes in risk behaviours resulting from the transition into prison, generalized estimating equation (GEE) methods were used. GEE was used to account for the correlated nature of repeated measurements among individual participants. Two longitudinal time points were used for each participant in order to represent the transition into prison: 3 months before entering prison, and at the first study visit following incarceration. GEE models were specified using a binomial family function, a logit link and an exchangeable correlation structure. Odds ratios (ORs) with corresponding 95% confidence intervals (CIs) and p-values were calculated. All adjusted models were adjusted for age at prison entry, sex, previous imprisonment, and time in prison at baseline. Due to the difference between how data were collected for the period before prison entry (in the last three months before prison entry) and at the first study visit following incarceration (since entering prison), a sensitivity analysis was performed restricting the analysis to people who had been in prison for a median of three months to ensure results were not biased by differences in follow-up time.

Factors associated with continuing injecting drug use following entry into prison were evaluated using logistic regression. Continuing injecting drug use was assessed only in the population who reported any injecting drug use in the three months before entering prison. Hypothesised prognostic covariates were chosen based on factors previously found to be associated with injecting drug use or those hypothesised to be associated with injecting drug use in prison, including the following variables reported for the three months before entering prison: age (per 10 years younger); sex (female vs male); methamphetamine injecting (yes vs no), cocaine injecting (yes vs no), heroin injecting (yes vs no), buprenorphine/methadone injecting (yes vs no), frequency of injecting drug use ($\geq$weekly vs $<$weekly), syringe sharing (yes vs no), previous imprisonment (yes vs no), and time in prison at the time of baseline interview (per year). Methamphetamine injecting included both methamphetamine and amphetamine injection.

Factors associated with re-initiating injecting following entry to prison among those with a history of injecting drug use without injecting in the three months prior to prison entry were evaluated by logistic regression. Hypothesised covariates associated with re-initiation of injecting drug use following entry into prison were chosen based on factors previously found to be associated with injecting drug use or those hypothesised to be associated with injecting drug use in prison, including the following variables as reported for the three months before entering prison: age (per 10 years younger); sex (female vs male); previous imprisonment (yes vs no), and time in prison at time of baseline interview (per year).

Lastly, calendar date of visit and age were evaluated for associations with injecting risk behaviour among those who were continuously imprisoned. Injecting risk behaviours assessed included any injecting drug use, $\geq$weekly injecting drug use (among those who reported injecting drug use), and needle/syringe sharing (among those who reported injecting drug use). GEE analyses were restricted to only those study visits where the participant had only been in prison since their last study visit (continuously imprisoned) in order to reliably attribute outcomes to the prison setting. Following unadjusted analysis, adjusted GEE analyses were performed to evaluate factors associated with ongoing injecting risk behaviours. Potential confounders were hypothesised a priori and included sex, time in prison at interview, and current OST at interview, and were included in all adjusted GEE models.

All statistically significant differences were assessed at $p < 0.05$; p values are two-sided. All analyses were performed using the statistical package Stata v13.1 (College Station, TX, United States).

Results

Participant characteristics

In total, 499 participants who enrolled in HITS-p from 2005 to 2009 were included in this analysis. The baseline participant characteristics are presented in Table 1. The majority of participants were male (65%) with a median age of 26 years. The median time in prison at enrolment was five months (IQR, 3–11 months) and the mean was 11 months (SD, 21 months). Overall, 71% (n = 354) of participants reported injecting drugs in the three months before entering prison and 31% (108/354) continued to inject following prison entry. Among those who did not inject in the three months before entering prison, 19% (28/145) reinitiated injecting following entry into prison.

Injecting risk behaviours prior to and following entry to prison

The proportion of subjects reporting any injecting drug use decreased from 71% (354 of 499) prior to prison entry to 27% (136 of 499) at the first enrolment visit in prison. The proportion reporting $>$weekly injecting drug use declined from 88% (312 of 354) prior to prison entry to 29% (39 of 136) at the first enrolment visit in prison. Among people who reported injecting drug use, the proportion reporting sharing a needle/syringe increased from 29%

Table 1
Characteristics of individuals enrolled in the HITS-p cohort between 2005 and 2009 and followed until 2014 (n = 499).

Characteristic, n (%)	Overall, n (%) (n = 499)
Age, years; median (Q1–Q3) [a]	26 (23–32)
Age, years; mean (SD)	28 (7)
Female sex	175 (35)
>10 years of schooling	117 (23)
Years since initiating injecting drug use [a], median (Q1–Q3)	8 (4–12)
Years since initiating injecting drug use [a], mean (SD)	9 (6)
Injecting drug use ever [a]	499 (100)
Methamphetamine	431 (86)
Cocaine	231 (46)
Heroin	325 (65)
Buprenorphine/methadone	167 (33)
Injecting drug use in the 3 months prior to incarceration	354 (71)
Injecting drug use at the first study visit following incarceration	136 (27)
Any sharing of injection equipment ever [a]	311 (62)
Current opioid substitution treatment [a]	108 (18)

[a] At baseline.

(69 of 354) prior to prison entry to 73% (99 of 136) at the first enrolment visit in prison.

Transition into prison was independently associated with decreased odds of reporting any injecting drug use (aOR 0.15, 95% CI 0.12–0.20). Among those who reported injecting drug use before entering prison, (n = 354), transition into prison was independently associated with decreased odds of ≥weekly injecting drug use (aOR 0.06, 95% CI 0.04–0.10) and increased odds of sharing a needle/syringe (aOR 9.84, 95% CI 6.38–15.18; Table 2). In sensitivity analyses among those with a median time of incarceration of three months, similar results were observed (Supplementary Table 3; Supplementary Fig. 1).

Among those who reported injecting prior to entering prison (n = 354), the drugs most often injected included methamphetamine (79%), heroin (46%), cocaine (26%), and buprenorphine/methadone (17%) (Fig. 1). Among those who reported injecting at the first enrolment visit in prison (n = 136), the drugs most often injected included heroin (55%), buprenorphine/methadone (53%), methamphetamine (41%), and cocaine (13%). Transition to prison was independently associated with decreased odds of injecting methamphetamines (aOR 0.21, 95% CI 0.14–0.30), injecting cocaine (aOR 0.30, 95% CI 0.17–0.51), and injecting other opioids (aOR 0.40, 95% CI 0.16–0.99) and increased odds of injecting buprenorphine/methadone (aOR 3.53, 95% CI 2.28–5.46; Table 2).

Factors associated with continued injecting drug use following entry into prison

Overall, 354 participants reported injecting drugs in the three months before entering prison and 38% (136/354) continued to inject following prison entry. Factors independently associated with continuing to inject were younger age (per 10 years; aOR 1.64, 95% CI 1.08–2.50), heroin injecting before prison entry (aOR 2.55, 95% CI 1.44–4.50), syringe sharing before prison entry (aOR 2.43, 95% CI 1.33–4.44), prior imprisonment (aOR 2.55, 95% CI 1.36–4.79), and time in prison at baseline (per year; aOR 1.55, 95% CI 1.27–1.90; Table 3).

Factors associated with re-initiation of injecting drug use following entry into prison

In adjusted analyses, factors which were independently associated with re-initiation of injecting drug (n = 145) use following prison entry were younger age (per 10 years; aOR 10.69, 95% CI 3.17–36.08) and longer time in prison at baseline (per year; aOR 1.62, 95% CI 1.23–2.13; Table 4).

Factors associated with ongoing injecting risk behaviours in prison

Among persons who were continuously imprisoned (n = 280), in the three months prior to prison entry, the proportion of participants reporting injecting drug use showed no relationship to age group and ranged between 63% and 71%. At the first enrolment visit in prison, the frequency of injecting drug use was highest in the youngest age groups (35% < 25 years; 10% ≥ 40 years). Among those who reported injecting drug use, injecting ≥weekly and needle/syringe sharing was highest among younger individuals (Fig. 2, Supplementary Table 2).

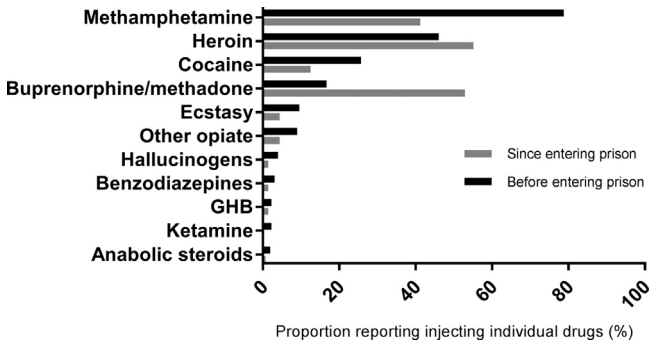

Fig. 1. Proportion of the participants that reported any injecting drug use who also reported injecting various drugs in the three months before entering prison (black) and at the first study visit following incarceration (grey).

Of the 499 participants included in this analysis, 280 participants had at least one period of continuous imprisonment. Younger age was independently associated with increased odds of reporting injecting drug use in prison (aOR 1.87, 95% CI 1.28–2.78). Calendar date of interview was not associated with injecting drug use in prison (Table 5).

Among continuously imprisoned participants who reported injecting drug use during follow-up in prison (n = 202), adjusted for time in prison at interview, current OST at interview, sex, and calendar date of interview, younger age was associated with increased odds of ≥weekly injecting drug use (aOR 1.72, 95% CI 1.05–2.86) as well as needle/syringe sharing in prison (aOR 2.00, 95% CI 1.28–3.13). Later calendar date of interview was independently associated with decreased odds of reporting needle/syringe sharing in prison (per year; aOR 0.95, 95% CI 0.92–0.98), but was not associated with ≥weekly injecting drug use (Table 6).

Discussion

This study investigated injecting risk behaviours among a cohort of PWID in the prison setting. The results demonstrate that following entry into prison, participants were less likely to report any injecting drug use, but among those who did inject, they were more likely to report sharing a needle/syringe. Younger age was associated with increased odds of continuing injecting, re-initiation of injecting, and ongoing injecting during follow-up in prison. These findings highlight the need for improved prevention strategies in prisons, given the high-risk of needle and syringe

Table 2
The association between the transition into prison and characteristics of injecting drug use, among those who injected before incarceration (n = 354).

Characteristics	OR	95% CI	*P*	aOR[a]	95% CI	*P*
Risk behaviours						
Frequency of injecting ≥weekly[a]	0.06	0.04–0.10	<0.001	0.06	0.04–0.10	<0.001
Syringe sharing[a]	9.81	6.50–14.81	<0.001	9.84	6.38–15.18	<0.001
Types of drugs						
Methamphetamine injecting[a]	0.20	0.14–0.29	<0.001	0.21	0.14–0.30	<0.001
Cocaine injecting[a]	0.33	0.19–0.56	<0.001	0.30	0.17–0.51	<0.001
Heroin injecting[a]	1.19	0.84–1.69	0.316	1.11	0.78–1.58	0.551
Buprenorphine/methadone injecting[a]	3.59	2.36–5.48	<0.001	3.53	2.28–5.46	<0.001
Other opiate injecting[a]	0.44	0.18–1.04	0.061	0.40	0.16–0.99	0.047

Characteristics were modelled as outcomes and imprisonment phase as the primary predictor in GEE analyses.
[a] Adjusted for age at prison entry, sex, previous imprisonment, and time in prison at baseline.

Table 3
Factors associated with continuation of injecting (n = 108) following entry into prison among participants who injected in the three months before entering prison (n = 354).

Variable	Discontinuation; n (%)	Continuation; n (%)	OR	95% CI	P	aOR	95% CI	P
Age (per 10 years younger); median (IQR)	27 (23–32)	25 (22–30)	1.41	0.98–2.03	0.062	1.64	1.08–2.50	0.023
Male sex	146 (59)	77 (71)	1.70	1.04–2.77	0.033	1.32	0.76–2.29	0.319
Methamphetamine injecting[a,b]	201 (82)	78 (72)	0.58	0.34–0.99	0.046	0.86	0.46–1.62	0.643
Cocaine injecting[a,b]	52 (21)	39 (36)	2.11	1.28–3.47	0.003	1.65	0.93–2.91	0.085
Heroin injecting[a,b]	95 (39)	68 (63)	2.70	1.69–4.31	<0.001	2.55	1.44–4.50	0.001
Buprenorphine/methadone injecting[a,b]	37 (15)	22 (20)	1.45	0.81–2.59	0.217	0.80	0.41–1.56	0.518
Frequency of injecting[a,b] (≥weekly vs. <weekly)	210 (86)	101 (94)	2.65	1.07–6.52	0.034	2.59	0.92–7.31	0.072
Syringe sharing[a,b]	37 (15)	32 (30)	2.38	1.38–4.09	0.002	2.43	1.33–4.44	0.004
Previous imprisonment	163 (66)	85 (79)	1.88	1.11–3.20	0.020	2.55	1.36–4.79	0.004
Time in prison at baseline interview (per year); median (IQR)	0.3 (0.2–0.8)	0.6 (0.3–1.2)	1.35	1.12–1.62	0.002	1.55	1.27–1.90	<0.001

[a] Among those who reported any injecting drug use.
[b] In the three months before entering prison; ORs from unadjusted and adjusted logistic regression analyses.

Table 4
Factors associated with re-initiation of injecting following entry (n = 28) into prison among participants who had not injected in the three months before entering prison (n = 145).

Variable	No re-initiation n (%)*	Re-initiation; n (%)*	OR	95% CI	P	aOR	95% CI	P
Age (per 10 years younger); median (IQR)	27 (23–35)	23 (21–26)	3.95	1.64–9.52	0.002	10.69	3.17–36.08	<0.001
Male sex	80 (68)	21 (75)	1.39	0.54–3.55	0.495	0.92	0.32–2.66	0.883
Previous imprisonment	78 (67)	17 (61)	0.94	0.78–1.13	0.49	1.10	0.89–1.35	0.387
Time in prison at baseline interview (per year)	0.4 (0.2–0.9)	1.0 (0.5–2.0)	1.13	0.97–1.32	0.112	1.62	1.23–2.13	0.001

ORs from unadjusted and adjusted logistic regression analyses.
* Percentages represent row percentages.

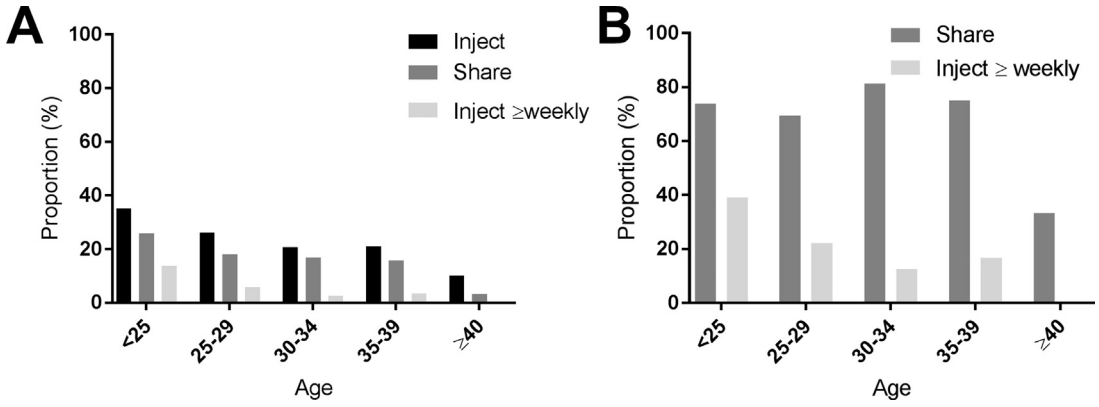

Fig. 2. Risk behaviours at the first study visit following incarceration stratified by age. Panel A represents the proportion of the entire population who reported injecting risk behaviours and panel B represents the proportion of the injecting population who reported sharing a needle/syringe and who reported injecting ≥weekly.

Table 5
Factors associated with injecting in prison, among continuously imprisoned participants (n = 280).

Outcome	Factor	OR	95% CI	P	aOR	95% CI	P
Injecting							
	Age (per 10 years younger)	1.64	1.16–2.27	0.004	1.87	1.28–2.78	0.001
	Interview date (per calendar year)	0.99	0.98–1.01	0.525	1.02	0.99–1.04	0.145
	Time in prison at interview	1.23	1.11–1.37	<0.001	1.36	1.19–1.54	<0.001
	Female sex	1.07	0.64–1.78	0.796	1.05	0.62–1.76	0.861
	Current OST at interview	2.02	1.30–3.13	0.002	2.04	1.30–3.20	0.002

ORs from unadjusted and adjusted GEE analyses.

sharing among people who inject drugs in prison. These data have important implications for targeting of prevention interventions, including targeting HCV treatment as prevention, high-coverage OST, and NSP, towards younger individuals in prisons.

Following entry into prison, the proportion of people who reported injecting drug use decreased, but among those who did inject drugs, needle and syringe sharing increased. This finding is consistent with previous studies that investigated injecting risk behaviour in prison, and found that those who inject in prison are more likely to share a needle and syringe than those in the community (Boelen et al., 2014; Dolan, Wodak, Hall, Gaughwin, & Rae, 1996; Malliori et al., 1998; Wright et al., 2015). This study provides novel longitudinal evidence of these changes among a consistent population of PWID. The increase in the proportion of PWID who report sharing a needle and syringe in prison is consistent with data from other studies in different settings which

Table 6
Factors associated with injecting ≥weekly in prison and needle/syringe sharing in prison among continuously imprisoned participants who reported injecting drug use during follow-up in prison (n = 202).

Outcome	Factor	OR	95% CI	*P*	aOR	95% CI	*P*
≥weekly injecting drug use							
	Age (per 10 years younger)	1.47	0.94–2.33	0.085	1.72	1.05–2.86	0.029
	Interview date (per calendar year)	1.00	0.97–1.04	0.837	1.02	0.99–1.06	0.215
	Time in prison at interview	1.12	1.00–1.25	0.045	1.25	1.09–1.44	0.002
	Female sex	0.92	0.50–1.68	0.781	1.08	0.58–2.00	0.806
	Current OST at interview	0.60	0.30–1.21	0.154	0.56	0.27–1.16	0.119
Needle/syringe sharing							
	Age (per 10 years younger)	2.50	1.67–3.85	<0.001	2.00	1.28–3.13	0.002
	Interview date (per calendar year)	0.93	0.90–0.95	<0.001	0.95	0.92–0.98	0.001
	Time in prison at interview	1.60	1.27–2.03	<0.001	1.59	1.23–2.06	<0.001
	Female sex	1.09	0.61–1.92	0.774	1.01	0.54–1.89	0.986
	Current OST at interview	2.29	1.38–3.79	0.001	1.98	1.16–3.41	0.013

ORs from unadjusted and adjusted GEE analyses.

have investigated needle and syringe sharing in prison (Weild et al., 2000; Wright et al., 2015). This increase is likely due to the lack of sterile injecting equipment in the prison environment (Dolan, Rutter, & Wodak, 2003; Lines, Jürgens, Betteridge, & Stöver, 2005). A previous study in the same cohort estimated the per injection event probability of HCV transmission in this setting to be 0.6% (Boelen et al., 2014). Together, these findings have important implications and demonstrate the need for NSP in this setting. Despite the evident need for NSP in prisons, there remains resistance to the implementation of prison-based NSP globally largely based on concerns of health and safety of prison workers and the idea that provision of injecting equipment would encourage drug use (Stoove, Treloar, Maher, Tyrrell, & Wallace, 2015). Although data is extremely limited regarding the impact of prison-based NSP on blood borne virus transmission and injecting risk behaviours, the available evidence suggests there is the potential for NSP to prevent ongoing transmission of HCV and HIV and reduce the prevalence of needle and syringe sharing without increasing the prevalence of injecting (Ferrer-Castro et al., 2012; Moller, van den Bergh, Karymbaeva, Esenamanova, & Muratalieva, 2008). Further, NSP in combination with OST has the potential to reduce the harm associated with injection-related bacterial infections through reduction of injection drug use and the provision of sterile injecting equipment and alcohol wipes for cleaning injection sites (Harm Reduction International, 2014; Hope, Hickman, Parry, & Ncube, 2014; Larney, Peacock, Mathers, Hickman, & Degenhardt, 2017). Given the resistance to implementation of NSP in prisons, this study provides important data which supports the recommendations made by the WHO that NSP services should be available in prisons as part of a comprehensive package of blood borne virus prevention strategies including OST and treatment for infections (Jurgens, Ball, & Verster, 2009).

Also of note are the reduced odds of injecting methamphetamines, cocaine, and other opiates and the increased odds of injecting buprenorphine/methadone following entry into prison. This suggests greater ease of access to buprenorphine/methadone in the NSW prison system as compared to other drugs. This access could either be the result of the diversion of medically supplied OST within prisons or could be an indication that more illicit buprenorphine/methadone is entering the prison system compared to other drugs (Jenkinson, Clark, Fry, & Dobbin, 2005; Roger, Lee, & Roche, 2011; Van Dyken et al., 2016; White et al., 2016). The introduction of sublingually administered buprenorphine film may have increased the ease with which illicit buprenorphine can be brought into prisons. Overall, the distribution of drugs injected in prison is consistent with a previous report (Indig et al., 2009).

In this study, younger age was associated with increased odds of both continuing injecting drug use and re-initiation of injecting drug use. This finding is consistent with previous studies of risk behaviours in both the community and the prison setting which have demonstrated higher prevalence of injecting risk behaviours among younger individuals (Butler et al., 2003; Kerr et al., 2010; Kinner, Jenkinson et al., 2012; Kinner, Milloy et al., 2012). This finding has important implications and suggests that the implementation of strategies for the prevention of HIV and HCV infections, including treatment as prevention, should be targeted towards younger individuals in prison.

This study also demonstrated decreased odds of needle and syringe sharing by calendar date. This decrease in needle and syringe sharing in prison over time potentially suggests an increased number of needles/syringes in the NSW prison system in recent years. Given that syringe sharing was associated with incident HCV infection in the HITS-p cohort, it is clear that sharing of needles/syringes in NSW prisons remains a problem regardless of the apparent reduction in sharing and argues for the provision of sterile injecting equipment through prison-based NSP.

There are limitations to this study. Measures, such as the use of study nurses independent of the custodial authority, were implemented in the collection of data to reduce potential response bias relating to disclosure of illegal behaviours, however such bias may still have affected the responses to survey questions. Any remaining response bias would likely have decreased the power to detect effects due to a reduced number of participants reporting any specific behaviour. Further, prior to prison entry, injecting risk behaviour data was collected for the period relating to the three months before entering prison, whereas while in prison, injecting risk behaviour data was initially collected for the period since entering prison. This has the potential to bias the results towards a higher proportion reporting injecting risk behaviours at the first visit following incarceration due to the longer mean time in prison when comparing the two periods. However, sensitivity analyses restricting the analysis to people in prison for a median of three months demonstrated similar results in the changes in injecting risk behaviours; hence this factor is unlikely to have impacted on the observed findings. Also, time in prison at study interview was included in all adjusted models to minimize the potential impact of time in prison on the findings. Lastly, given the design of the study, which only included prisons in NSW and the inability to compare these results to those prisoners who were not included in the study, the results are not necessarily generalisable to the general prison population in NSW. Further, these results from NSW prisons, where OST and provision of bleach for cleansing injecting equipment is available (but NSP services are not), are not necessarily generalisable to other prison populations nationally or internationally, particularly in regions with differing prevention strategies available inside and outside of prison. Irrespective of

these limitations, to our knowledge, this study is one of the only prospective prison-based studies to evaluate trends in injecting risk behaviours and provides valuable data to inform the implementation of prevention strategies in prison settings.

Given the high prevalence of HCV among prison inmates globally, prison populations represent an important population in which to implement HCV prevention strategies, including treatment as prevention. The advent of highly effective, well tolerated HCV direct-acting antiviral (DAA) therapies has made treatment as prevention a realistic strategy to work towards WHO elimination targets for HCV (Hajarizadeh et al., 2016; World Health Organization, 2016). However, many countries currently restrict access to HCV DAA therapies to those with advanced liver disease, actively exclude PWID, and do not offer treatment to prisoners (Barua et al., 2015; Marshall et al., 2017; Marshall et al., 2016). Further data on injecting risk behaviours is needed to effectively implement treatment as prevention in prisons. This study demonstrates that high-risk behaviours are common among PWID in the Australian prison system and that younger individuals are most likely to exhibit high-risk behaviours in prison. Further, these data illustrate key demographic and behavioural predictors of injecting drug use in prison and contribute essential data for the effective implementation of HCV prevention strategies in this setting. Additional studies in this setting are needed to evaluate HCV prevention strategies, including the implementation of HCV treatment as prevention and NSP to work towards elimination of HCV in prisons.

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Contributors

AL, FL were responsible for design and implementation of the HITS-p study. EBC, JG, AL, LD, SL, GJD were responsible for design and implementation of this analysis. EBC, JG, BH, JA, NAB were responsible for analysis of the data. EBC was responsible for writing the manuscript. All authors reviewed and gave approval for publication.

Conflicts of interest

GJD is a consultant/advisor and has received research grants from AbbVie, Abbot Diagnostics, Bristol-Myers Squibb, Cepheid, Gilead, GlaxoSmithKline, Merck, Janssen and Roche. JG is a consultant/advisor and has received research grants from AbbVie, Bristol-Myers Squibb, Cepheid, Gilead Sciences and Merck/MSD. AL is a consultant/advisor and has received research grants from Bristol-Myers Squibb, Gilead and Merck.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.drugpo.2017.12.013.

References

Abiona, T. C., Balogun, J. A., Adefuye, A. S., & Sloan, P. E. (2009). Pre-incarceration HIV risk behaviours of male and female inmates. *The International Journal of Prisoner Health*, *5*(2), 59–70. http://dx.doi.org/10.1080/17449200902880524.

Aspinall, E. J., Weir, A., Sacks-Davis, R., Spelman, T., Grebely, J., Higgs, P., ... Hellard, M. E. (2014). Does informing people who inject drugs of their hepatitis C status influence their injecting behaviour? Analysis of the Networks II study. *International Journal of Drug Policy*, *25*(1), 179–182. http://dx.doi.org/10.1016/j.drugpo.2013.08.005.

Barua, S., Greenwald, R., Grebely, J., Dore, G. J., Swan, T., & Taylor, L. E. (2015). Restrictions for medicaid reimbursement of sofosbuvir for the treatment of hepatitis C virus infection in the United States. *Annals of Internal Medicine*, *163*(3). http://dx.doi.org/10.7326/M15-0406215–+.

Boelen, L., Teutsch, S., Wilson, D. P., Dolan, K., Dore, G. J., Lloyd, A. R., ... investigators, H. (2014). Per-event probability of hepatitis C infection during sharing of injecting equipment. *Public Library of Science*, *9*(7). http://dx.doi.org/10.1371/journal.pone.0100749e100749.

Bretana, N. A., Boelen, L., Bull, R., Teutsch, S., White, P. A., Lloyd, A. R., ... investigators, H. I.-p. (2015). Transmission of hepatitis C virus among prisoners, Australia, 2005–2012. *Emerging Infectious Diseases*, *21*(5), 765–774. http://dx.doi.org/10.3201/eid2105.141832.

Butler, T., Levy, M., Dolan, K., & Kaldor, J. (2003). Drug use and its correlates in an australian prisoner population. *Addiction Research & Theory*, *11*(2), 89–101. http://dx.doi.org/10.1080/1606635021000021403.

Butler, T., Callander, D., & Simpson, M. (2015). *National prison entrants bloodborne virus and risk behaviour survey report 2004 2007, 2010 and 2013*. Retrieved from https://kirby.unsw.edu.au/report/national-prison-entrants-bloodborne-virus-and-risk-behaviour-survey-report-2004-2007-2010.

Cunningham, E. B., Hajarizadeh, B., Bretana, N. A., Amin, J., Betz-Stablein, B., Dore, G. J., ... the H.-p.i (2017). Ongoing incident hepatitis C virus infection among people with a history of injecting drug use in an Australian prison setting , 2005–2014: The HITS-p study. *Journal of Viral Hepatitis*, *24*(9), 733–741. http://dx.doi.org/10.1111/jvh.12701.

Degenhardt, L., Mathers, B., Vickerman, P., Rhodes, T., Latkin, C., & Hickman, M. (2010). Prevention of HIV infection for people who inject drugs: Why individual, structural, and combination approaches are needed. *Lancet*, *376*(9737), 285–301. http://dx.doi.org/10.1016/S0140-6736(10)60742-8.

Dolan, K., Wodak, A., Hall, W., Gaughwin, M., & Rae, F. (1996). HIV risk behaviour of IDUs before, during and after imprisonment in New South Wales. *Addiction Research*, *4*(2), 151–160. http://dx.doi.org/10.3109/16066359609010754.

Dolan, K., Rutter, S., & Wodak, A. D. (2003). Prison-based syringe exchange programmes: A review of international research and development. *Addiction*, *98*(2), 153–158. http://dx.doi.org/10.1046/j.1360-0443.2003.00309.x.

Dolan, K., Teutsch, S., Scheuer, N., Levy, M., Rawlinson, W., Kaldor, J., ... Haber, P. (2010). Incidence and risk for acute hepatitis C infection during imprisonment in Australia. *European Journal of Epidemiology*, *25*(2), 143–148. http://dx.doi.org/10.1007/s10654-009-9421-0.

Dolan, K., Wirtz, A. L., Moazen, B., Ndeffo-mbah, M., Galvani, A., Kinner, S. A., ... Altice, F. L. (2016). Global burden of HIV, viral hepatitis, and tuberculosis in prisoners and detainees. *Lancet*, *388*(10049), 1089–1102. http://dx.doi.org/10.1016/S0140-6736(16)30466-4.

Fazel, S., Bains, P., & Doll, H. (2006). Substance abuse and dependence in prisoners: A systematic review. *Addiction*, *101*(2), 181–191. http://dx.doi.org/10.1111/j.1360-0443.2006.01316.x.

Ferrer-Castro, V., Crespo-Leiro, M. R., Garcia-Marcos, L. S., Perez-Rivas, M., Alonso-Conde, A., Garcia-Fernandez, I., ... Sanjose-Vallejo, R. (2012). Evaluation of needle exchange program at Pereiro de Aguiar prison (Ourense, Spain): ten years of experience. *Revista Española de Sanidad Penitenciaria*, *14*(1), 3–11. http://dx.doi.org/10.1590/s1575-06202012000100002.

Grebely, J., Robaeys, G., Bruggmann, P., Aghemo, A., Backmund, M., Bruneau, J., ... International Network for Hepatitis in Substance, U. (2015). Recommendations for the management of hepatitis C virus infection among people who inject drugs. *International Journal of Drug Policy*, *26*(10), 1028–1038. http://dx.doi.org/10.1016/j.drugpo.2015.07.005.

Hagan, H., Pouget, E. R., & Des Jarlais, D. C. (2011). A systematic review and meta-analysis of interventions to prevent hepatitis C virus infection in people who inject drugs. *The Journal of Infectious Diseases*, *204*(1), 74–83. http://dx.doi.org/10.1093/infdis/jir196.

Hajarizadeh, B., Grebely, J., & Dore, G. J. (2013). Epidemiology and natural history of HCV infection. *Nature Reviews Gastroenterology & Hepatology*, *10*(9), 553–562. http://dx.doi.org/10.1038/nrgastro.2013.107.

Hajarizadeh, B., Grebely, J., Martinello, M., Matthews, G. V., Lloyd, A. R., & Dore, G. J. (2016). Hepatitis C treatment as prevention: Evidence, feasibility, and

challenges. *The Lancet Gastroenterology & Hepatology*, *1*(4), 317–327. http://dx.doi.org/10.1016/S2468-1253(16)30075-9.
Harm Reduction International (2014). *The global state of harm reduction*. Retrieved from https://www.hri.global/files/2015/02/16/GSHR2014.pdf.
Hayashi, K., Milloy, M. J., Fairbairn, N., Kaplan, K., Lai, C., Wood, E., & Kerr, T. (2009). Incarceration experiences among a community-recruited sample of injection drug users in Bangkok, Thailand. *BMC Public Health*, *9*(1), 492. http://dx.doi.org/10.1186/1471-2458-9-492.
Hope, V. D., Hickman, M., Parry, J. V., & Ncube, F. (2014). Factors associated with recent symptoms of an injection site infection or injury among people who inject drugs in three English cities. *International Journal of Drug Policy*, *25*(2), 303–307. http://dx.doi.org/10.1016/j.drugpo.2013.11.012.
Indig, D., Topp, L., Ross, B., Mamoon, H., Border, B., Kumar, S., & McNamara, M. (2009). *2009 NSW inmate health survey: Key findings report*. NSW Health.
Jenkinson, R. A., Clark, N. C., Fry, C. L., & Dobbin, M. (2005). Buprenorphine diversion and injection in Melbourne, Australia: An emerging issue? *Addiction*, *100*(2), 197–205. http://dx.doi.org/10.1111/j.1360-0443.2004.00958.x.
Jurgens, R., Ball, A., & Verster, A. (2009). Interventions to reduce HIV transmission related to injecting drug use in prison. *Lancet Infectious Diseases*, *9*(1), 57–66.
Kerr, T., Small, W., Buchner, C., Zhang, R., Li, K., Montaner, J., & Wood, E. (2010). Syringe sharing and HIV incidence among injection drug users and increased access to sterile syringes. *American Journal of Public Health*, *100*(8), 1449–1453. http://dx.doi.org/10.2105/Ajph.2009.178467.
Kinner, S. A., Jenkinson, R., Gouillou, M., & Milloy, M. J. (2012). High-risk drug-use practices among a large sample of Australian prisoners. *Drug and Alcohol Dependence*, *126*(1–2), 156–160. http://dx.doi.org/10.1016/j.drugalcdep.2012.05.008.
Kinner, S. A., Milloy, M. J., Wood, E., Qi, J. Z., Zhang, R., & Kerr, T. (2012). Incidence and risk factors for non-fatal overdose among a cohort of recently incarcerated illicit drug users. *Addictive Behaviors*, *37*(6), 691–696. http://dx.doi.org/10.1016/j.addbeh.2012.01.019.
Larney, S., Kopinski, H., Beckwith, C. G., Zaller, N. D., Jarlais, D. D., Hagan, H., ... Degenhardt, L. (2013). Incidence and prevalence of hepatitis C in prisons and other closed settings: Results of a systematic review and meta-analysis. *Hepatology*, *58*(4), 1215–1224. http://dx.doi.org/10.1002/hep.26387.
Larney, S., Peacock, A., Mathers, B. M., Hickman, M., & Degenhardt, L. (2017). A systematic review of injecting-related injury and disease among people who inject drugs. *Drug and Alcohol Dependence*, *171*(Supplement C), 39–49. http://dx.doi.org/10.1016/j.drugalcdep.2016.11.029.
Lavanchy, D. (2009). The global burden of hepatitis C. *Liver International*, *29*, 74–81. http://dx.doi.org/10.1111/j.1478-3231.2008.01934.x.
Lines, R., Jürgens, R., Betteridge, G., & Stöver, H. (2005). Taking action to reduce injecting drug-related harms in prisons: The evidence of effectiveness of prison needle exchange in six countries. *The International Journal of Prisoner Health*, *1*(1), 49–64. http://dx.doi.org/10.1080/17449200500157085.
MacArthur, G. J., van Velzen, E., Palmateer, N., Kimber, J., Pharris, A., Hope, V., ... Hutchinson, S. J. (2014). Interventions to prevent HIV and Hepatitis C in people who inject drugs: A review of reviews to assess evidence of effectiveness. *International Journal of Drug Policy*, *25*(1), 34–52. http://dx.doi.org/10.1016/j.drugpo.2013.07.001.
Malliori, M., Sypsa, V., Psichogiou, M., Touloumi, G., Skoutelis, A., Tassopoulos, N., ... Stefanis, C. (1998). A survey of bloodborne viruses and associated risk behaviours in Greek prisons. *Addiction*, *93*(2), 243–251. http://dx.doi.org/10.1046/j.1360-0443.1998.9322438.x.
Marshall, A. D., Saeed, S., Barrett, L., Cooper, C. L., Treloar, C., Bruneau, J., ... Grebely, J. (2016). Restrictions for reimbursement of direct-acting antiviral treatment for hepatitis C virus infection in Canada: A descriptive study. *CMAJ Open*, *4*(4). http://dx.doi.org/10.9778/cmajo.20160008E605–e614.
Marshall, A. D., Cunningham, E. B., Nielsen, S., Aghemo, A., Alho, H., Backmund, M., ... Grebely, J. (2017). Restrictions for reimbursement of interferon-free direct-acting antiviral drugs for HCV infection in Europe. *The Lancet Gastroenterology & Hepatology*. http://dx.doi.org/10.1016/S2468-1253(17)30284-4Epub ahead of print.
Moller, L. F., van den Bergh, B. J., Karymbaeva, S., Esenamanova, A., & Muratalieva, R. (2008). Drug use in prisons in Kyrgyzstan: A study about the effect of health promotion among prisoners. *The International Journal of Prisoner Health*, *4*(3), 124–133. http://dx.doi.org/10.1080/17449200802264654.
Nelson, P. K., Mathers, B. M., Cowie, B., Hagan, H., Des Jarlais, D., Horyniak, D., & Degenhardt, L. (2011). Global epidemiology of hepatitis B and hepatitis C in people who inject drugs: Results of systematic reviews. *The Lancet*, *378*(9791), 571–583. http://dx.doi.org/10.1016/s0140-6736(11)61097-0.
Nolan, S., Dias Lima, V., Fairbairn, N., Kerr, T., Montaner, J., Grebely, J., & Wood, E. (2014). The impact of methadone maintenance therapy on hepatitis C incidence among illicit drug users. *Addiction*, *109*(12), 2053–2059. http://dx.doi.org/10.1111/add.12682.
Platt, L., Reed, J., Minozzi, S., Vickerman, P., Hagan, H., French, C., & Hickman, M. (2016). Effectiveness of needle/syringe programmes and opiate substitution therapy in preventing HCV transmission among people who inject drugs. *Cochrane Database of Systematic Reviews*, *2016*(1). http://dx.doi.org/10.1002/14651858.CD012021.
Pollini, R. A., Alvelais, J., Gallardo, M., Vera, A., Lozada, R., Magis-Rodriquez, C., & Strathdee, S. A. (2009). The harm inside: Injection during incarceration among male injection drug users in Tijuana, Mexico. *Drug and Alcohol Dependence*, *103*(1–2), 52–58. http://dx.doi.org/10.1016/j.drugalcdep.2009.03.005.
Roger, N., Lee, N., & Roche, A. (2011). *Pharmaceutical drug misuse in Australia: Complex problems, balanced responses*. Retrieved from http://nceta.flinders.edu.au/files/6113/2823/3742/EN448_Nicholas_2011.pdf.
Stoove, M., Treloar, C. J., Maher, L., Tyrrell, H., & Wallace, J. (2015). Salvaging a prison needle and syringe program trial in Australia requires leadership and respect for evidence. *Medical Journal of Australia*, *203*(8), 319–320. http://dx.doi.org/10.5694/mja15.00523.
Tsui, J. I., Evans, J. L., Lum, P. J., Hahn, J. A., & Page, K. (2014). Association of opioid agonist therapy with lower incidence of hepatitis C virus infection in young adult injection drug users. *JAMA Internal Medicine*, *174*(12), 1974–1981. http://dx.doi.org/10.1001/jamainternmed.2014.5416.
Turner, K. M., Hutchinson, S., Vickerman, P., Hope, V., Craine, N., Palmateer, N., ... Hickman, M. (2011). The impact of needle and syringe provision and opiate substitution therapy on the incidence of hepatitis C virus in injecting drug users: Pooling of UK evidence. *Addiction*, *106*(11), 1978–1988. http://dx.doi.org/10.1111/j.1360-0443.2011.03515.x.
Van Dyken, E., Lai, F., Thai, P. K., Ort, C., Bruno, R., Hall, W., ... Prichard, J. (2016). Challenges and opportunities in using wastewater analysis to measure drug use in a small prison facility. *Drug and Alcohol Review*, *35*(2), 138–147. http://dx.doi.org/10.1111/dar.12156.
Watkins, R. E., Mak, D. B., & Connelly, C. (2011). Identifying high risk groups for sexually transmitted infections and blood borne viruses upon admission to prison in Western Australia. *Rural and Remote Health*, *11*(2).
Weild, A. R., Gill, O. N., Bennett, D., Livingstone, S. J., Parry, J. V., & Curran, L. (2000). Prevalence of HIV, hepatitis B, and hepatitis C antibodies in prisoners in England and Wales: A national survey. *Communicable Disease and Public Health*, *3*(2), 121–126.
White, B., Dore, G. J., Lloyd, A. R., Rawlinson, W. D., & Maher, L. (2014). Opioid substitution therapy protects against hepatitis C virus acquisition in people who inject drugs: The HITS-c study. *Medical Journal of Australia*, *201*(6), 326–329.
White, N., Ali, R., Larance, B., Zador, D., Mattick, R. P., & Degenhardt, L. (2016). The extramedical use and diversion of opioid substitution medications and other medications in prison settings in Australia following the introduction of buprenorphine-naloxone film. *Drug and Alcohol Review*, *35*(1), 76–82. http://dx.doi.org/10.1111/dar.12317.
World Health Organization (2016). *Combating hepatitis B and C to reach elimination by 2030*. Retrieved from http://apps.who.int/iris/handle/10665/206453.
Wright, N. M. J., Tompkins, C. N. E., & Farragher, T. M. (2015). Injecting drug use in prison: Prevalence and implications for needle exchange policy. *International Journal of Prisoner Health*, *11*(1). http://dx.doi.org/10.1108/Ijph-09-2014-003217–+.
van den Berg, C. H., Smit, C., Bakker, M., Geskus, R. B., Berkhout, B., Jurriaans, S., ... Prins, M. (2007). Major decline of hepatitis C virus incidence rate over two decades in a cohort of drug users. *European Journal of Epidemiology*, *22*(3), 183–193. http://dx.doi.org/10.1007/s10654-006-9089-7.